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The "Invisible hand" of Digital Economy

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Abstract

The transition of conventional economics to the data-driven digital economy has become a focal point for the scientific community in the adjustment and transfer of basic economic principles and parameters in the metaverse. Thus, the context of interdependence among countries created by globalisation has allowed for a new form of interdependence to emerge, through the increasing role of cross-border data flows as a new key resource in international economic relations and development. The main purpose of this research paper is to study the evolution of the digital economy under the impact of major effects that occur in a severe and dramatic context with many widespread potentially negative consequences. With the development of Industry 4.0, the concept of digital economy must be endorsed by international policymaking, which is flexible and takes into account the countries different levels of digital maturity, as well as development objectives or digital readiness. Since the last three years have been characterised by an overlapping of black swans with the disruptive effect of full lockdown, the digital transition to digital economy has begun to gather pace. The methodology used implied both a quantitative and qualitative analysis, following a thorough scoping review of scientific literature, by means of a macroeconomic approach with the purpose to assess the major four components of the digital economy: gross domestic product (GDP), economic output, employment, and the Outsourcing growth rate from the IT sector. The research was centred on the case of the potential for the digitization from Romania to become a key player in ensuring true support for the Romanian economic prevalence under very unlikely events compared to the EU27.

Keywords: digital economy, digitalisation, digital transition, Industry 4.0, black swan, pandemic, COVID-19.

JEL Classification: E60, O33, O47.

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1. Introduction

Humanity's recent history has been marked by multiple series of *black swans* (Taleb, 2010) that have been proved to play an essential role in how we perceive and use digital technologies. Thus, the COVID-19 pandemic has created the ideal setting for the steep rise of digitalization, which was no longer perceived as an alternative way of addressing economic issues, but as an intrinsic obligation to respond to people's needs in a contemporary fashion.

The pandemic has also emphasised the increasing dependence of our societies in relation to the potential role that data can play in combating global crises through data-driven digital technologies. Real-time data and technology assistance made it possible for the governments to monitor and control the spread of the pandemic, and to cooperate with scientists in order to develop new vaccines in record time (UN, 2021). Using cross-border data solutions and technology collaborations on an international scale, governments were able to fight a crisis that spread across national borders and affected human beings all over the world.

In order to address the increasing number of interconnection and interdependence challenges in the global data economy, the developed countries paved the road for the entire world to implement the design model of their digital economies and institutions. Yet, the current industrial revolution driven by the force of digital technology has been foreseen for more than fifty years ago, when Moore stated that the number of transistors in a dense integrated circuit (IC) doubles every two years (Moore, 1998). As an extension of this technological development, digital equipment diversified exponentially its operational capabilities in terms of storage capacity and processing speed of computers, or even home appliances wireless connected to our mobile phones.

Nowadays companies benefit from the constant monitoring and control of machinery equipped with technologies by process optimisation of their energy efficiency. Hence, digital technologized companies have been able to reduce their electricity and thermal consumption, water and waste consumption and even labour costs (Maggiore et al., 2021). In a new COVID-19 reshaped world, social distance and lockdown measures transformed the way we carried out our daily activities, and home became the new headquarters of teleworking, shopping, socialising, or receiving education.

In the light of the recent pandemic, the Southern European countries have adopted national recovery measures in the interest of addressing the social inequalities, teacher-training deficit, and the distribution of educational opportunities with solid further investments in the digitization process (Zancajo et al., 2022). Regarding the role of IoT technologies in the transition to the digital economy, both the IoT and the economy are affected by highly unexpected events, technological innovations, economic developments, or production (Nistor, Zadobrischi, 2022). As a result, the digital economy could not be perceived as an alternative solution for our societies, but as the main tool behind the force of economic recovery. The decline in human development worldwide due to the confluence of crises generated by the

COVID-19 pandemic was equivalent to erasing six years of progress, due to the contraction of GDP, trade, employment, and investment (Larionova, 2020).

Taking into account the intensive interest manifested over the last five years by the scientific community in the process of digital transformation from both macroeconomic and microeconomic perspectives, this paper aims to evaluate the potential for the Industry 4.0 to positively impact economic growth, as well as address social inequalities and act as an *Invisible hand* in the economic recovery process for the Romanian economy.

Furthermore, the main focus of this research condensed on a comparative macroeconomic analysis between Romania, EU27, and G-20 countries, with the mission to determine the performance of digital economies under an overlapping crisis.

2. Literature Review

The current phenomenon of digital technologies has culminated around 2015 and most research studies focus on business and economic implications, but omit related initiatives, such as Work 4.0, Management 4.0, Marketing 4.0, and others (Maresova et al., 2018). Still, even if digital transformation can occur in countries with very different economic backgrounds (Corejova et al. 2021), digitalization must be endorsed by complementary strategies to support the extremely poor to share the benefits of economic digital transformation (Subramaniam et al., 2020).

Research studies focused on the COVID-19 pandemic impact on the potential for digital transformation under *black swans*' effect have also concluded that an economy in crisis has a negative impact on the potential for digital transformation (Corejova et al., 2021). With regard to the European economies, one of the main issues to be addressed in order to reduce the gap in the sustainable and inclusive economic growth is the competitiveness performance of high-tech and digitalized industries in the global production value chains (Boikova et al., 2021).

The trend towards Industry 4.0 acts like an *invisible hand* that erases boundaries between manufacturing industries, service enterprises, IT-providers, and tech data giants (Winter, 2020) and sets the scene for the expansion of the paradigm of digital economy. Due to the perfect setting of uncertainties and pressures generated by the pandemic, the metaverse gained traction throughout the creation of new value by the means of data-driven innovation technologies (European Commission, 2021).

Studies show that one of the main factors that could help close the digital gap between the extremely poor people and the rest of the world is the governments' role in ensuring that the benefits of digitalization could be reaped by people who live in extreme poverty as well (Subramaniam et al., 2020). Other authors also concluded that globalisation and e-government development improve economic growth and eradicate poverty and income inequality by boosting digitalization, investments, job creation, and wage increases for the semi-skilled and unskilled labour-intensive workforce (Ullah et al., 2021). Other studies focus on the Internet and Communication Technology (ICT) impact on economic growth and

development, highlighting the positive contribution of ICT's regardless of the country's development level (Habibi, Zabardast, 2020).

In the light of European's Union goal to create a single digital market that uses its first computer with quantum acceleration (COM, 2021/262 final), the European Commission offers support to member states in designing and implementing growth-enhancing reforms and facilitating the digital transition in areas such as e-government, digital economy, digital infrastructure development (broadband), e-health, and digital skills through the Technical Support Instrument (EU, 2021/241). Therefore, the European Commission has been using the Digital Economy and Society Index (DESI) since 2014 as a comprehensive tool in monitoring member states' digital progress and offering an overview of the state of digitalisation in Europe. The DESI 2021 reports reflect the member states' ambitions for the next six years, as expressed in their Recovery and Resilience Facility (RRF), starting from a 2020 baseline (European Commission, 2021).

The global village that interconnects millions of people through the digital economy must solve our current challenges and achieve the Sustainable Development Goals (Espinosa et al., 2021). In contrast, the costs of anti-pandemic measures, the drop in revenues, and growing debt on top of historically high pre-crisis debt levels became long-term threats to sustainable development (Larionova, 2020).

3. Research Questions

The main purpose of this research is to study the impact of digitalization, digital economy, and economic growth under the *black swan* effect. The main focus of this research concentrated on a comparative analysis between Romania, the European Union, and G-20 countries, in order to assess the performance of digital economies under an overlapping crisis. Taking into account the current trend to fastening the economic decoupling using the advantages offered by the Industry 4.0, the research questions proposed are:

1) What is the current state of Romania's digitisation process?
2) How did the COVID-19 pandemic affect the transition of Romania's economy to the digital economy, compared to the most developed countries?
3) What are the key elements that could provide an increasing potential for Romania's digital economy to expand rapidly and fill the gap in terms of economic growth among the most developed countries?

4. Research Methods

Digital economy is strongly related to the digital transformation, which implied a thorough scoping review of more than 200 scientific papers published between 2017 and 2022 for synthesising research evidence. The scoping process implied the use of various academic scientific libraries identified in the Web of Science database that offer both open and institutional access to their scientific literature in the economic and social sciences field. For the purpose of this article, the online search

was refined by applying two-word combinations of the following keywords: digital economy, digitalisation, digital transition, Industry 4.0, black swan, pandemic, COVID-19.

Then, a macroeconomic approach was applied with the purpose to assess the four major components of the digital economy by conducting a qualitative analysis of the following: gross domestic product (GDP), economic output, employment, and the Outsourcing growth rate from the IT sector. The Digital Economy and Society Index measures the degree to which the digitization transition has been successfully provided to improve the methodology and to take into consideration the latest technological and policy developments.

The structure of DESI indicators has changed along with the continuous expansion of the digital economy and consists of four cardinal points of the Digital Compass that replace the former dimension of five: human capital, connectivity, integration of digital technologies, and digital public services. Also, the main objective of this assessment of the progress towards the green and digital economy is to investigate the targets' achievement in a comparative scenario between Romania and the EU27 over the last five years.

Next, the Global Innovation Index (GII) takes into account more than 80 indicators which measure the level of Innovation inputs and outputs in order to offer a comprehensive view over world economies in terms of innovation capabilities. Since the analysis of the relationship between innovation input and output performance is directly linked to the level of economic performance, the impact of the pandemic was investigated from a comparative perspective of Romania's GII with Europe and top ten countries.

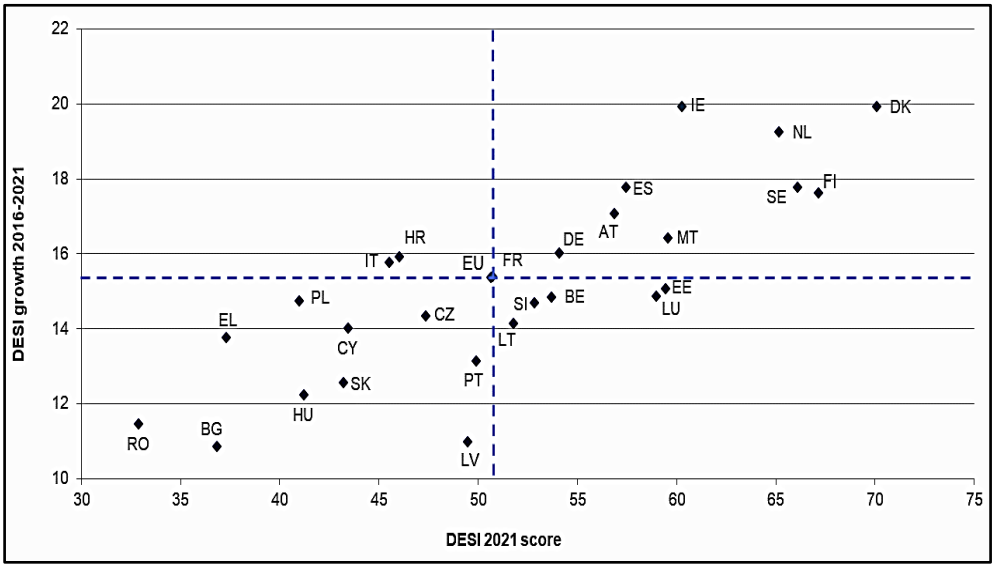
As stated by the World Intellectual Property Organization (WIPO), the GII is determined by seven fundamental pillars: knowledge and technology outputs, infrastructure, Global Innovation Index 2021, Institutions, Business sophistication, creative outputs, market sophistication, human capital, and research. Even if GII data are available only for the last decade, these reports provide a useful overview of the 130 United Nations' economies with respect to their innovation capabilities.

5. Findings

According to the Digital Compass target, member states must facilitate the transition to fully digital key public services for their citizens and businesses with optimal quality and efficiency. As stated by the European Commission (DESI, 2021), the Digital Economy and Society Index monitors the online provision of public services by scoring member states on whether or not they have completed each step of key services completely online.

Over the last five years, Romania is one of the countries from the bottom of the hierarchy, scoring the lowest progress in terms of digitalisation, along with Bulgaria and Latvia, as shown in the figure below (Figure 1). On the contrary, the most significant progression in the digital transformation was noted by Denmark, Netherlands, Spain, and Finland with the highest scores.

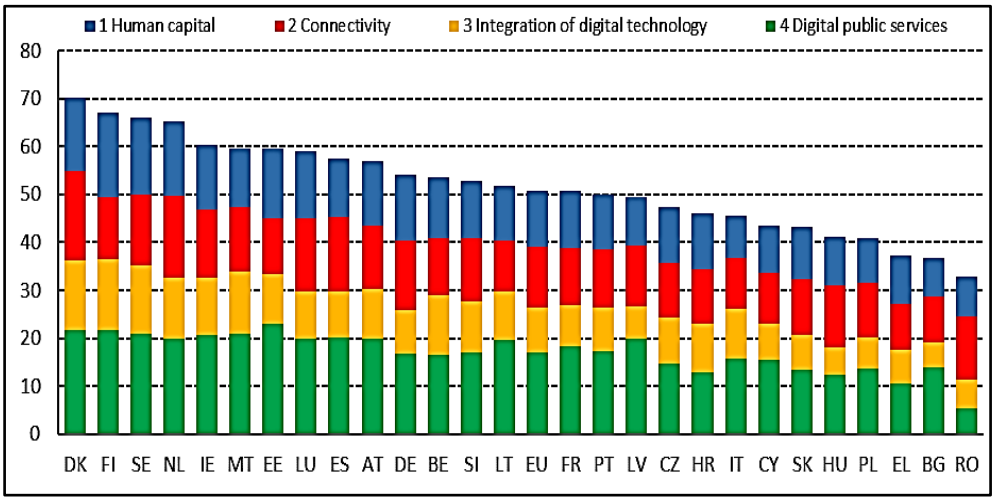
Figure 1. Digital Economy and Society Index- Member States' progress, 2016-2021



Source: DESI 2021, European Commission.

If the pandemic acted as a propulsion force for many developing countries to adjust and rethink their transition to the digital economy, it was clearly not the case for Romania, which remained the less advanced digital economy in the European Union in 2021, followed by Bulgaria and Greece (Figure 2). The list of countries with the most advanced digital economies in the EU remains constant: Denmark, Finland, Sweden, and the Netherlands.

Figure 2. Digital Economy and Society Index in EU, 2021



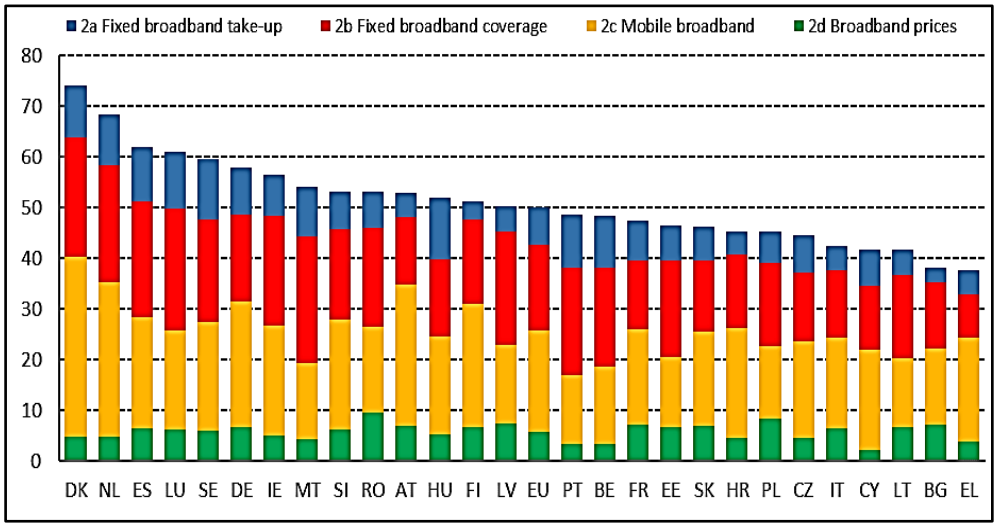
Source: DESI 2021, European Commission.

In terms of connectivity, the Digital Economy and Society Index (DESI) measures both the demand and the supply side of fixed and mobile broadband, assessing not only the availability of fast broadband and fixed very high-capacity networks, but also the population coverage of 4G and 5G networks and the retail prices of fixed and mobile offers.

While being the less advanced digital economy in the EU, Romania succeeded in achieving one of the highest scores for the mobile broadband sub-dimension, among the top ten most developed countries in the broadband connectivity dimension. The best score was once again noted by Denmark, followed by the Netherlands, Spain, and Luxembourg. On the other hand, Bulgaria and Greece do not benefit from the same connectivity opportunities, hence their lowest scores (Figure 3).

The integration of digital technology in EU states measures the level of digitalisation of businesses and e-commerce, by the means of ten different digital technology indicators: SMEs (Small and Medium Enterprises) with at least a basic level of digital intensity, electronic information sharing, social media, big data, cloud, AI, ICT for environmental sustainability, e-Invoices, SMEs selling online, e-Commerce turnover, and selling online cross-border.

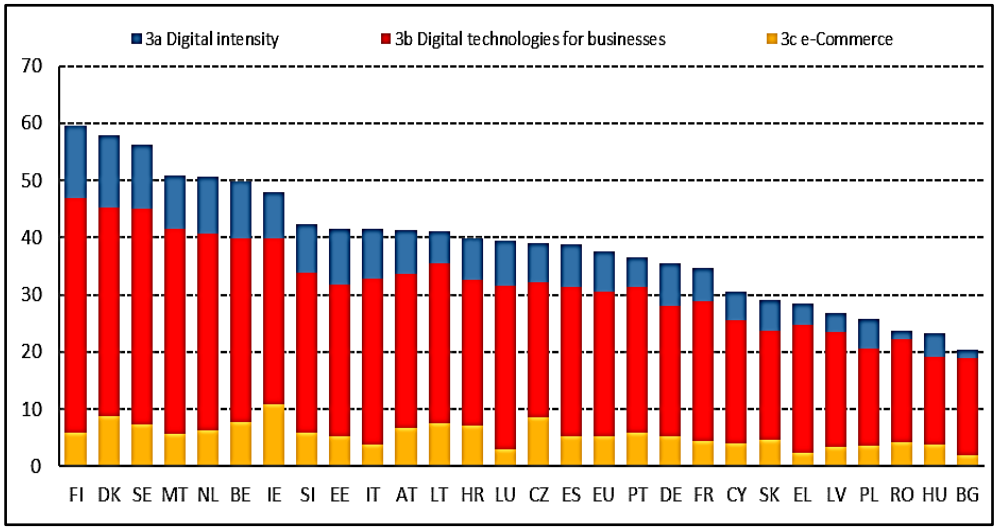
Figure 3. Digital Economy and Society Index 2021, Connectivity in EU states



Source: DESI 2021, European Commission.

As shown in the figure below (Figure 4), Romania has one of the weakest performances in the integration of digital technologies, still scoring better than Hungary or Bulgaria, while Finland and Denmark achieved the best performance.

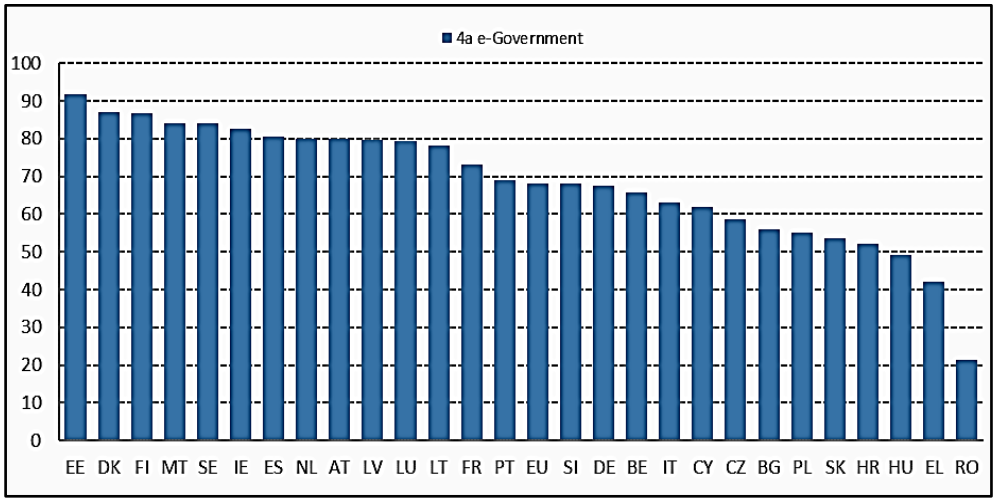
Figure 4. Digital Economy and Society Index 2021, Integration of digital technology in EU states



Source: DESI 2021, European Commission.

Since effective e-government has the capacity to provide a wide range of benefits, including more efficiency and savings for both governments and businesses, as well as an increasing transparency and openness, it is very important to study member states' ability to implement digital public services according to their Digital Decade targets. According to Figure 5 below, Romania and Greece have the lowest score of open data and digital public services, while Estonia, Denmark, and Finland have almost fully achieved their target in the digitalisation of the public sector.

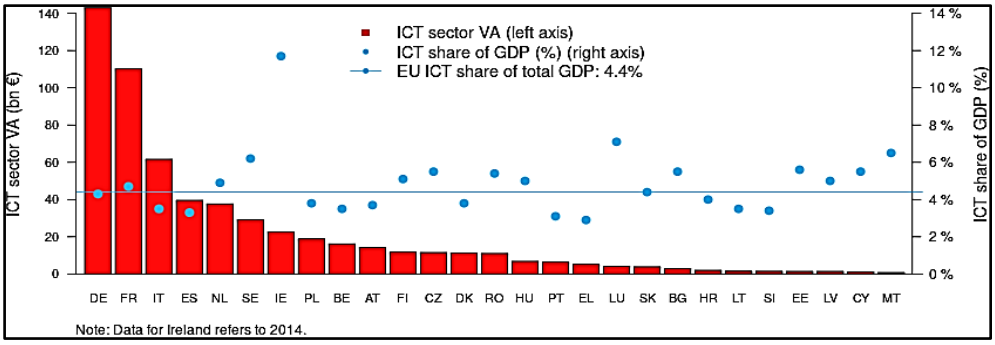
Figure 5. Digital Economy and Society Index 2021, Digital public services in EU states



Source: DESI 2021, European Commission.

Romania contributed to ICT value added in 2018 with EUR 55 billion or 5% of EU value added in ICT, while the average European level of ICT as percentage of GDP was 4.4% (Figure 6). On the other hand, Denmark has a less large ICT sector as percentage of GDP (4%), while Bulgaria, Czechia, Cyprus, Estonia, Malta, and Luxembourg have the largest ICT sector as percentage of GDP (all more than 5.5%).

Figure 6. ICT sector Value Added, EU27, EUR billion, 2018 (left axis) and ICT sector share of GDP, EU27, %, 2018 (right axis)

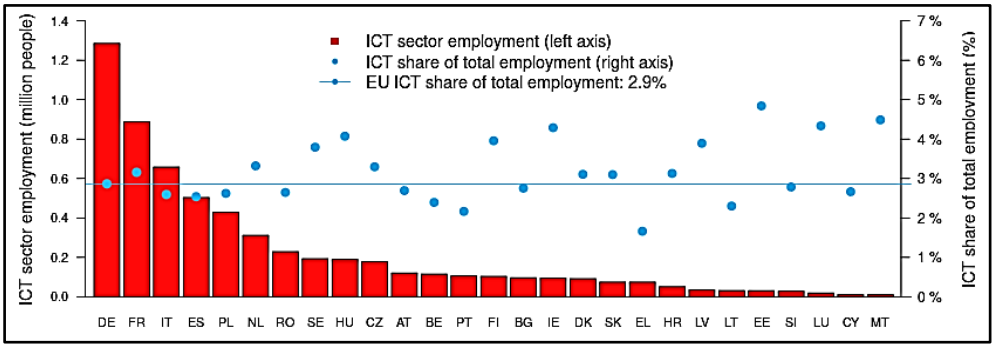


Source: DESI 2021, European Commission.

More than 64% of total ICT sector employment in the European Union in 2018 was accounted for by the top five largest employers: Germany with over 1.3 million people, equivalent to 22% of total EU ICT workforce, followed by France with almost 900.000 people (or 15%), Italy with 650.000 people (or 11%), Spain with 500.000 people (or 9%) and Poland with 430.000 employees in the ICT sector (or 7%). In Romania, almost 250.000 people are employed in the ICT sector, placing the Romanian state among the top seven countries in terms of employment in the ICT area (Figure 7).

On the contrary, many other countries accounted for weak performance in terms of employment in the ICT sector. For instance, Greece had the smallest ICT sector share over total employment, with 1.7%.

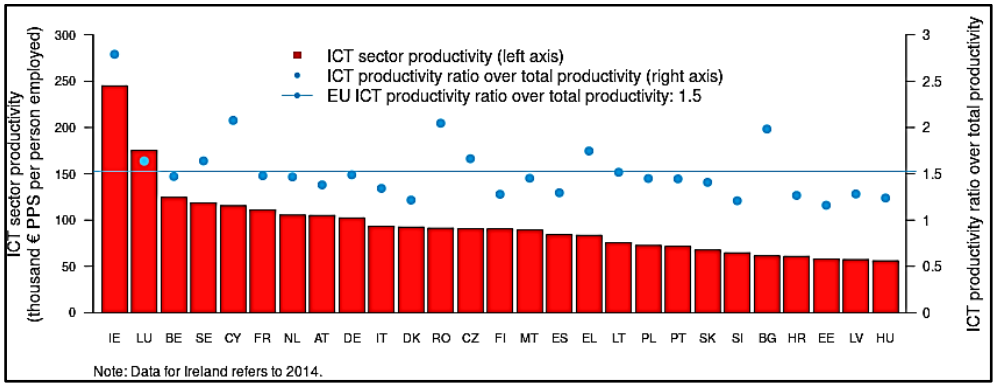
Figure 7. Employment in the ICT sector, EU27, million individuals, 2018 (left axis) and ICT sector share of total employment, EU27, %, 2018 (right axis)



Source: DESI 2021, European Commission.

The average level of labour productivity in the EU27 ICT sector referring to services and trade was EUR 101.000 per person employed in 2018, while labour productivity in the telecommunications sub-sector was the highest (more than EUR 169.000 per employee). As shown in the figure below, Romania and Bulgaria are once again at the bottom of the scale in terms of labour productivity in the economy (Figure 8). Nonetheless, these countries have a good performance expressed by the ratio of labour productivity in the ICT sector over the economy.

Figure 8. Productivity in the ICT sector, EU27, thousand EUR PPS / individual employed, 2018 (left axis) and ratio of ICT productivity over total productivity, EU27 (right axis)



Source: DESI 2021, European Commission.

Next, the following table (Table 1) presents the position of Romania between 2019 and 2021 in the hierarchy of world economies, in accordance with their innovation capabilities. There is clear evidence that the pandemic stopped Romania's development in terms of innovation because 2021 marked a lower rank than 2020 for both innovation inputs (rank 54 in 2021 versus 51 in 2020) and outputs (rank 50 in 2021 compared to 46 in 2020). Also, in 2021 Romania fell two positions in the global economies rank for the GII, from the 46th place in 2020.

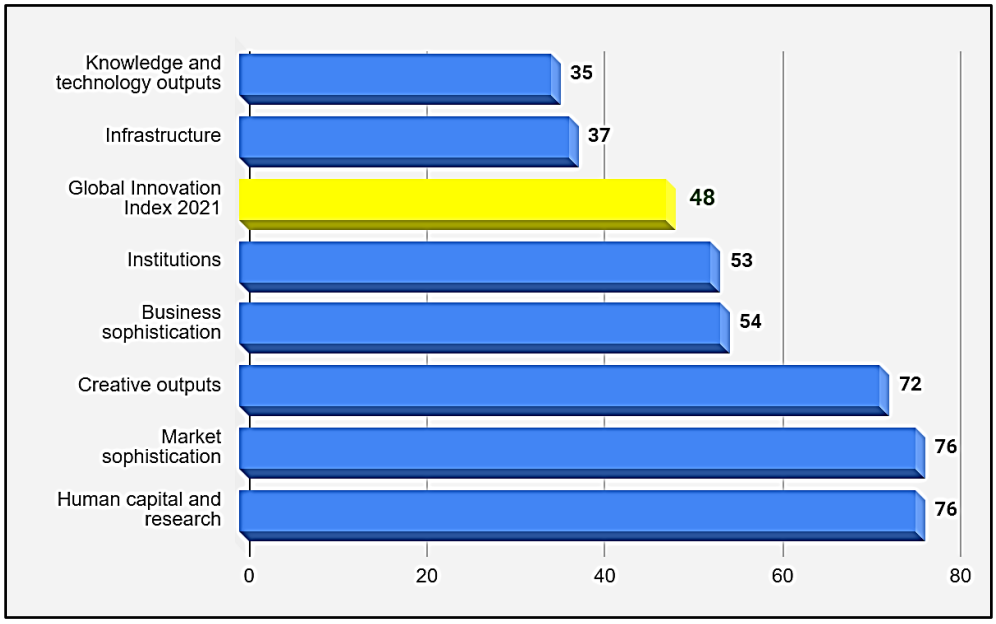
Table 1. Global Innovation Index of Romania, 2019-2021

Year	Innovation inputs	Innovation outputs	GII
2019	54	53	50
2020	51	46	46
2021	54	50	48

Source: Authors' contribution using GII 2021, United Nations databases.

Despite the fact that Romania performs below the high-income group average in all GII pillars, as well as below the regional average in all GII pillars, its best performance is represented by the knowledge and technology outputs. As presented in Figure 9, Romania must quickly adapt and find new solutions to address the challenges in market sophistication, human capital and research, and creative outputs, which perform in a negative direction and place Romania in the second half of the hierarchy.

Figure 9. The seven GII pillar ranks for Romania in 2021



Source: Authors' contribution using GII 2021, United Nations databases.

Note: The highest possible ranking in each pillar is one, from a total of 130 countries.

According to the National Institute of Statistics, the Romanian IT exports market has been in a continuous expansion by 15% each year, being estimated at $5.5 billion in 2021. With an even higher annual outsourcing growth rate of 20%, Romania exports approximately 90% of ITO services to the EU27 countries (UK, France, Germany, the Netherlands, or the Nordic countries).

The cost-effectiveness perspective of Western countries in choosing Romanian software development services that have similar prices to other Eastern European countries is underlined by the cheap IT labour force. Another great advantage of the Romanian IT outsourcing market is the high level of professional skills of the second largest hub of software engineers in Europe (after Ukraine) that can provide customised delivery models for the best quality-cost ratio, depending on the buyer's preferences and budget.

In addition, companies involved in the software development area are exempted by the Romanian government from paying any tax on income for their employees,

and they can also receive a 50% deduction on their research and development costs. Therefore, Romania is one of the most competitive countries in terms of outsourcing.

As presented in Romania's National Recovery and Resilience Plan, based on a green and digital economic transformation, public services digitalisation is the main element that must be addressed for the e-Government to be realised. Another fundamental priority of the Romanian government's IT strategy is the Digitalization of the public sector, upon the application of corresponding cybersecurity programs.

Once the COVID-19 pushed the transition to digitalisation as a response to the need for social distancing, the context was seen by the Romanian early adopters as a high-priority opportunity for the e-Government implementation strategy.

6. Conclusions

Affected by the convergence of both the sanitary crisis and the natural hazards that occurred during the last two years, the impact of COVID-19 worsened the financial gap between developed and developing countries (Izumi and Shaw, 2022). This traumatic period of lockdown experience and a chaotic e-learning experiment for many teachers, students, families, or even policymakers, has accelerated the transition to an immediate digitalization (Zancajo et al., 2022).

Previous research has already highlighted the lack of sufficient financial government support and investments in innovations and training conducted by the SMEs in countries with a very low degree of implementation of digital technologies (Trasca et al., 2019). This is the case of Romania, Bulgaria and Hungary that have been rated as "beginners" in terms of digital maturity of SMEs, due to their inability to adopt simple technological solutions (Brodny, Tutak, 2022).

Our findings concerning the evolution of the digital economy, under the impact of major effects that occur in a severe and dramatic context with many widespread potentially negative consequences, suggest that digitalisation plays a decisive role in accelerating the post-pandemic recovery process.

Through the scoping review analysis, it was possible to answer all the research questions addressed in this paper. Thus, the limitations of this study have been the use of a single scientific database (Web of Science) and the analysis of online publications, taking into account only the specific keywords indicated previously.

On the one hand, sound macroeconomic policies and regulations must be adopted in order to address post-pandemic recovery and increase economic resilience. To this purpose, the Industry 4.0 could prove to be an effective ally for the policy makers to develop different policies that aim decarbonisation goals and energy efficiency mechanisms specifically designed to support energy efficiency in the industrial sector (Maggiore et al., 2021).

Learning from the post-epidemic recovery from China, an effective way to cope and mitigate such external shocks is strengthening economic resilience and establishing a more complete risk emergency mechanism and social governance system, and thus ensure the stability of the economic operating environment and promote economic resilience (Jiang et al., 2022).

However, the positive impact of digitalisation on climaxing the climate emergency and achieving absolute decoupling could be submerged by the continuing quantitative growth of the global economic activity (Kunkel, Tyfield, 2021).

On the other hand, governments must increase their investment in the educational systems, which has already been proven to positively impact economic growth and eventually provide the economic and knowledge base for higher education (Volchik et al., 2018).

From the perspective of Romania's potential for digital transition and its current state of digitisation, we found that the Romanian state figures among top seven countries from EU27, in terms of employment in the ICT area, while the COVID-19 pandemic slowed the conversion of Romania's economy to the digital economy. As a result, Romania ranks in the last position among the European countries having the least advanced digital economy in the European Union in 2021, followed by Bulgaria and Greece.

Moreover, Romania has one of the weakest performances from the EU27 states in the integration of digital technologies, open data and digital public services, and labour productivity in the economy. In contrast, the Romanian economy has a good performance, delivered by the ratio of labour productivity in the ICT sector over the economy.

Furthermore, Romania fell two positions in the global economies rank for the Global Innovation Index, arriving on the 48th place in 2021. Given the fact that Romania has a lower score than the high-income group average in all GII pillars, as well as compared to the regional average in all GII pillars, its best performance is portrayed by the knowledge and technology outputs.

Regarding the future lines of search, it is strongly recommended to extend the current combination of keywords used in the bibliometric analysis, in order to include social or geographical clusters for a better interpretation of results, in accordance with their specific context.

For the digital economy to be fully implemented, Romania must strengthen collaboration between the public and private sector, but also inter-sectoral and intra-sectoral collaboration, which is why further research should focus on identifying different models of organisational structures in terms of regulations, policies, and guiding principles that could be transferred in the transformation process towards a decoupling economy.

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